Erosion: Water + Soil = Impact

Objectives

Students will (1) describe the process of erosion, (2) how sand, silt, or both affect water flow; and (3) identify how vegetation and human activities can affect sand, silt, or both in surface water.

Curricular Areas

Science, English Language Arts, and Social Studies

Method

Students create a model to simulate the affects of erosion in a stream. Students will add sand, silt and a combination of both to the system and note the results. Students will test the use of vegetation to help prevent erosion.

California Content Standards

GRADES 3-8

Science

3rd Life 3 c, d, e; Investigations 5 b, d, e
4th Life 3 b, c; Earth 5 a, b, c; Investigations 6 a, c, d
5th Earth Science 3 e; Investigations 6 h
6th Earth 2 a, b
7th Earth/Life 4 c; Investigations 7 c, e
8th Motion 1 a; Investigations 9 a

Social Studies

3rd 3.1
4th 4.1

English Language Arts

3rd Speaking 1.0
4th Speaking 1.0; 2.0
5th Writing 2.0; Speaking 1.0, 2.0
6th Writing 2.0; Speaking 2.0
7th Writing 2.0, Speaking 2.0

Materials

- Time to complete: (1) 50-minute class period

For each group of four students:

- Clear plastic 1-gallon container such as a storage box
- Pea-sized gravel to cover the bottom of the container
- Water (fill container to 1 inch from the top)
- 1 cup coarse sand
- 1 cup silt (silica powder, or fine dirt, from stream-edge)
- three straws per person
- brightly colored beads (pea-sized or larger)
- plastic tablecloth
- paper towels

For class observation experiment:

- 2 aluminum roasting pans, 3 inches deep
- soil for each container
- lawn sod or turf for one container
- 2 plastic tablecloths
- spray bottle or watering can
- 2 clear plastic containers to catch runoff water
- wooden blocks to elevate one end of aluminum pan
- scissors to cut drain in aluminum pan

Background

One material moving through the watershed is soil. Sediments (soil) enter water in two main forms:

1. Surface erosion sheds small amounts of particles into the water.
2. Mass erosion (e.g., landslides) dumps huge amounts of dirt into water.

Causes of surface erosion vary. They can include anglers walking trails to favorite fishing spots, or cattle trampling and consuming streamside vegetation that holds soil in place. Logging, mining, and road construction can also contribute to surface erosion. Mass erosion, such as mudslides or earth slumps, occurs more frequently on hillsides altered by human activity, such as clear-cut logging, road construction, or home building.

Soil being carried by water is a natural ongoing process. Erosion has occurred since water appeared on the planet. However, sedimentation may affect aquatic wildlife by altering nutrients, diminishing sunlight to plants, and altering stream energy and velocity. One important effect of sedimentation is to block the flow of water to organisms residing

in bottom substrates. The flow of clean water is important in most aquatic environments because flowing water often carries dissolved oxygen that aquatic animals need for respiration. Depletion of oxygen in bodies of water affects organisms even at early stages of development. For instance, salmon lay their eggs in gravel that receives a flow of clean water, either from a stream or river, or from spring water percolating up from the lake bottom. As the water flows over the eggs, it delivers dissolved oxygen to them. If the eggs do not receive enough oxygen, they die. Silt and sand enter streams through erosion. Silt and sand act like concrete to block water movement, and thus diminish the amount of oxygen reaching the developing eggs. Once the erosion-causing activity is stopped, streams may cleanse themselves. (Depending on the extent of the problem, self-cleansing can take from 1 to 20 years.)

The major purpose of this activity is to show that aquatic wildlife and its habitat can be influenced by land-based activities in the surrounding watershed.

Procedure

Before class:

1. Set up a container with gravel and a small handful of colored beads covered by water as an example for students. Post a large sheet of paper on the wall for groups to record their results. A sample observation chart is at the conclusion of the activity.
2. For the second experiment, prepare two aluminum pans. Cut a drain into one side of each pan (see diagram). Bend the cut aluminum to form the drain. Fill pans; in one put a shallow layer of soil topped with lawn sod or turf. The second pan should have only soil (pack down the soil so that it is as firm as possible).

During class

1. Ask students if they can define erosion. When the rain falls and washes down the hills into the valleys, what happens to the soil? Where does this soil go? What happens when this soil goes into a river? Explain that the students will conduct an experiment and make inferences about the affect that sediment may have on the life in river.
2. Ask the students why oxygen is important to aquatic animals. How does a fish breathe? How does the oxygen get into the water? (You may review the riffles and pool information.) Remind students that increased turbidity due to sediment can interfere with sunlight transmission, fish respiration and plant photosynthesis.
3. Place students into groups of three or four. Ask each group to gather the supplies and set up its demonstration. Explain the three parts of the procedure (Steps 4, 5, and 6 below), and ask students to predict what will happen as each sediment type is added to the water.
4. Each person in the group should simultaneously blow bubbles into the water with a straw. Make sure the straw is at or near the bottom of the container so that the end is pushed into the layer of gravel. Have each group discuss the ease or difficulty in blowing bubbles and record the observations on the sheet on the wall. Remind students that the blowing of bubbles is meant to demonstrate how water moves in different situations.
5. Instruct the groups to add 1 cup of sand to the water and then to blow bubbles again. Be sure that the straw is pushed through the sand so that it reaches the gravel. The group then discusses the difficulty level and records its observations on the master sheet on the wall.
6. Now add 1 cup of silt to the water, allowing it to settle, and push the end of the straw into the layer of gravel and blow bubbles again. The group then discusses the difficulty level and records its observations on the master sheet on the wall.
7. Conduct a class discussion about the demonstration and results, and describe what these results might mean to aquatic organisms and their need for clean water. What happened to the colored beads? What if the beads were salmon eggs? Will the sediment affect the survival of the eggs? How do sand and silt get into the water? Which of these sources are human and which are natural? What can happen to fish and other

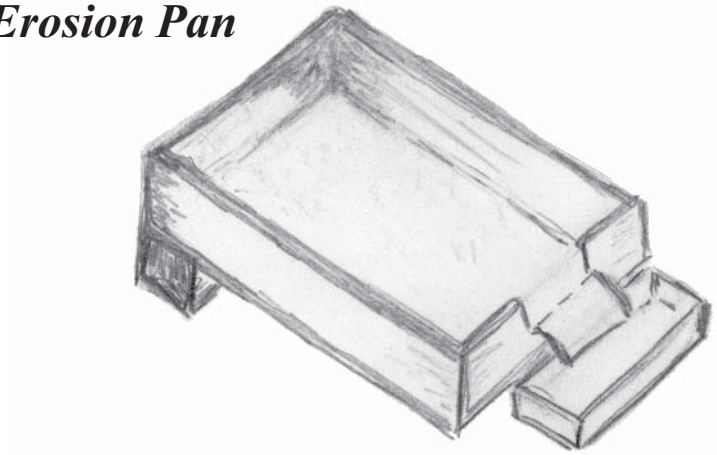
aquatic organisms if too much sediment gets into aquatic systems?

8. Is there someway to prevent sediment from entering the waterways? Have students brainstorm things that might reduce siltation. Would vegetation growing along riverbanks help? Explain that the next simple experiment will demonstrate the effect of vegetation on erosion.
9. Set up the class observation experiment. Place the pans on a plastic covered table and elevate the end opposite the drain. Below the pan drain place a clear plastic pan or jar to collect the water runoff. *Suggestion:* place a plastic sheet on the floor.
10. Now create a rainstorm. Use a spray bottle or watering can to simulate rain. Look at the water in each container. Is there a difference? What made the difference? Have students make inferences concerning vegetation and riparian areas. Is there something that can help minimize erosion when human activity disturbs the natural landscape?
11. Conclude the lesson by asking students to summarize facts they learned from both activities. Key points include:
    - gradual erosion is a part of natural dynamics,
    - human activities can accelerate the process,
    - excessive silt can have an impact upon plants and animals, and
    - vegetation can help minimize the erosion process.

Extension

1. Research and discuss ways to minimize the addition of sand or silt into natural aquatic systems.
2. Explore how people living in an urban area might help minimize siltation with water conservation.
3. Develop a plan for a riparian restoration

Erosion Pan



- Cut a 3” pan 1.5” to 2” deep and 3” to 4” wide.
- Bend the cut portion to form a drain to guide water into catch pan.
- Elevate the pan to facilitate the water run off.
- Collect runoff in a clear plastic container.

Erosion Observation Chart

Difficulty Levels	**Group 1**	**Group 2**	**Group 3**	**Group 4**
Clean Water				
Easy to blow				
Less easy to blow				
Hard to blow				
Sand in Water				
Easy to blow				
Less easy to blow				
Hard to blow				
Sand & Silt in Water				
Easy to blow				
Less easy to blow				
Hard to blow				